Claims

What is claimed is:

1. A shift reactor **(16HT, 16LT)** for reducing the amount of carbon monoxide in a process gas containing at least carbon monoxide and water, using a water gas shift reaction, the shift reactor having a reaction chamber **(32)**, the chamber having an inlet **(36)** for entry of the process gas into the chamber, an outlet **(38)** downstream of the inlet **(36)** for exit of effluent from the chamber **(32)**, and a catalyst bed **(34, 50)** located between the inlet **(36)** and the outlet **(38)** for converting at least a portion of the carbon monoxide and water in the process gas into carbon dioxide and hydrogen, the improvement comprising:

means **(40, 40A, 40B, 40C, 40D, 41A, 41B, 41C, 41D)** for adding oxygen to the process gas in, or prior to, the reaction chamber **(32)** for causing a reaction in the reaction chamber **(32)** to enhance conversion of the carbon monoxide in the process gas.

2. The shift reactor **(16HT, 16LT)** of claim **1** wherein the quantity of oxygen added to the process gas is less than about 2.0 mol%.

3. The shift reactor **(16HT, 16LT)** of claim **2** wherein the quantity of oxygen admitted to the reaction chamber is about 0.2 mol%, or less.

4. The shift reactor **(16HT, 16LT)** of claim **1** wherein the catalyst bed **(34, 50)** in the reaction chamber **(32)** comprises one or more metals having a promoted support, the metal being selected from the group consisting of the noble metals and the group of non-noble metals consisting of chromium, manganese, iron, cobalt, and

nickel, and the promoted support comprising at least a metal oxide.

5. The shift reactor **(16HT, 16LT)** of claim **4** wherein the catalyst bed **(34, 50)** comprises a precious metal from the group of noble metals consisting of platinum, palladium, rhodium, and gold, and the metal oxide of the promoted support includes at least one of cerium oxide (ceria) and zirconium oxide (zirconia).

6. The shift reactor **(16HT, 16LT)** of claim **1** wherein the catalyst bed **(34, 50)** requires neither prereduction, a shutdown purge, nor an inerting atmosphere to operate.

7. The shift reactor **(16HT, 16LT)** of claim **6** wherein the shift reactor is operatively connected in a fuel processing subsystem **(14, 16HT, 16LT, 18)** for a fuel cell **(12)**.

8. The shift reactor **(16HT, 16LT)** of claim **4** wherein the shift reactor **(16HT, 16LT)** includes a high temperature stage **(16HT)** and a low temperature stage **(16LT)**, and said means **(40, 40A, 40B, 40C, 40D, 41A, 41B, 41C, 41D)** for adding oxygen to the process gas introduces said oxygen to the process gas substantially at said low temperature stage **(16LT)**.

9. The shift reactor **(16HT, 16LT)** of claim **1** wherein the addition of oxygen to the process gas causes an oxidation reaction in the reaction chamber **(32)** for converting a portion of carbon monoxide in the process gas to carbon dioxide.

10. The method of reducing the amount of carbon monoxide in a process fuel gas, comprising the steps of:

a. placing a catalyst bed **(34, 50)** in a water gas shift reactor **(16HT, 16LT)**;

b. feeding **(36)** the process fuel gas into operative proximity with the catalyst bed **(34, 50)** to convert at least a portion of the carbon monoxide in the process fuel gas into carbon dioxide via a water gas shift reaction; and

c. supplying oxygen **(40, 40A, 40B, 40C, 40D, 41A, 41B, 41C, 41D)** to the process fuel gas near, or prior to, the catalyst bed **(34, 50)** for further converting carbon monoxide in the process fuel gas.

11. The method of claim **10** wherein the catalyst bed **(34, 50)** is selected from one or more metals having a promoted support, the metal being selected from the group consisting of the noble metals and the group of non-noble metals consisting of chromium, manganese, iron, cobalt, and nickel, and the promoted support comprising at least a metal oxide, and wherein the quantity of oxygen added to the process fuel gas is less than about 2.0 mol%.

12. The method of claim **11** wherein the quantity of oxygen is about 0.2 mol%, or less.

13. The method of claim **11** wherein the step of supplying oxygen **(40, 40A, 40B, 40C, 40D, 41A, 41B, 41C, 41D)** to the process fuel gas comprises varying **(41A, 41B, 41C, 41D)** the quantity of oxygen supplied to attain a desired response.

14. The method of claim **10** wherein the step of supplying oxygen **(40, 40A, 40B, 40C, 40D, 41A, 41B, 41C, 41D)** to the process fuel gas near, or prior to, the catalyst bed **(34, 50)** effects an oxidation reaction for further converting carbon monoxide in the process fuel gas to carbon dioxide